

A compact low-loss photonic crystal demultiplexer based on the focusing superprism effect

B. Momeni and A. Adibi,
School of Electrical and Computer Engineering, Georgia Institute of Technology,
Atlanta, GA 30332-0250 USA.

Superprism-based photonic crystal demultiplexers have recently received considerable attention due to their capabilities for realizing compact optical demultiplexers and spectrometers. However, it has been shown that in their conventional configuration, very large propagation lengths are required for high-resolution applications (e.g., in dense wavelength division multiplexing (DWDM) devices) [1]-[2] due to the diffraction of optical beams that correspond to different wavelength channels.

Here, we show that the source of limited resolution in these structures is the inherent diffraction effects on the optical beams propagating in the photonic crystal region. We show for the first time that by appropriate preconditioning of the beam, a focusing superprism effect can be realized, and devices made based on this concept can be an order of magnitude more compact compared to the conventional superprism-based devices. The key innovation in this proposed work is the combination of demultiplexing and focusing by carefully engineering the dispersion of photonic crystal. To the best of our knowledge, our result is the first actual demonstration of wavelength photonic crystal demultiplexers with practical length achievable using existing electron beam lithography and dry etching.

In addition to reducing the length of the device by at least one order of magnitude, we also introduce for the first time adiabatic matching stages [3] at the input and output interface of the photonic crystal demultiplexer to reduce the reflection losses considerably. The overall goal of this presentation is demonstration of an efficient, compact, and low-loss photonic crystal based demultiplexer.

- [1] T. Baba and T. Matsumoto, *Applied Physics Letters*, **81**, 2325 (2002).
- [2] B. Momeni and A. Adibi, *Applied Physics B*, **77**, 555 (2003).
- [3] B. Momeni and A. Adibi, to appear in *Proceedings of SPIE, Photonics West 2005*, San Jose, CA (2005) and submitted to *Optics Communications*.